CLAIMS

1. A method for manufacturing activated carbon, comprising:

a mixing step for mixing a carbonaceous material and an alkali metal hydroxide while maintaining a solid state;

a granulating step for granulating the mixture obtained in the mixing step while maintaining its solid state;

a dehydrating step for dehydrating the granules obtained in the granulating step while maintaining its solid state; and

an activating step for subjecting the dehydration product obtained in the dehydration step to an activation treatment to give an activated carbon.

2. The manufacturing method according to claim 1, wherein the temperature of the granulation treatment is 80°C or more in the granulation step.

3. The manufacturing method according to claim 1 or 2, wherein the pressure of the granulation treatment is 0.01 to 300 Torr, and the temperature of the granulation treatment is 90 to 140°C in the granulation step.

4. The manufacturing method according to any of claims 1 to 3, wherein the maximum diameter of the granulation product obtained in the granulation step is 50 mm or less.

5. The manufacturing method according to any of claims 1 or 4, wherein the temperature of the dehydration treatment is 200°C or more in the dehydration step.

6. The manaufacturing method according to any of claims 1 to 5, wherein the pressure of the dehydration treatment is 0.01 to 10 Torr, and the temperature of the dehydration treatment is 200 to 400°C in the dehydration step.

7. The manufacturing method according to claim 1, wherein the pressure (Torr) and the temperature rise rate (°C/minute) are set so as to satisfy the following equation (2),

$$Pv < 15 \qquad (2)$$

where in the equation, P is the pressure (Torr) during the dehydration treatment, and v is the temperature rise rate (°C/minute) during the dehydration treatment.

8. The manufacturing method according to any of claims 1 to 7, wherein the carbonaceous material is an easily graphitizable carbonaceous material.

9. The manufacturing method according to any of claims 1 to 8, wherein the carbonaceous material is a mesophase pitch carbon fiber.

10. The manufacturing method according to claim 9, wherein the mesophase pitch carbon fiber is a pitch carbon fiber containing 50 vol% or more of an optically anisotropic phase.

11. The manufacturing method according to any of claims 1 to 9, wherein the carbonaceous material used in the mixing step comprises grains with a maximum length of 500 μm or less in the direction of the major axis.

12. The manufacturing method according to any of claims 1 to 11, wherein the alkali metal hydroxide has an average particle diameter of 1 mm or less.

13. The manufacturing method according to any of claims 1 to 12, wherein the alkali metal hydroxide is sodium hydroxide and/or potassium hydroxide.

14. The manufacturing method according to any of claims 1 to 13, wherein no less than 1 part by weight of alkali metal hydroxide is mixed with 1 part by weight of carbonaceous material in the mixing step.

15. The manufacturing method according to any of claims 1 to 14, wherein the activation treatment temperature in the activation step is 500°C to 900°C.

16. The manufacturing method according to claim 1, wherein the rate at which the temperature is raised to 200 to 600°C is 5°C/minute or less, and the holding time at a holding temperature of 700°C or more is 0.5 to 8 hours in the activation step.

17. The manufacturing method according to claim 16, wherein the rate at which the temperature is raised to 200 to 600°C is 2°C/minute or less.

18. The manufacturing method according to claim 16 or 17, wherein the holding time at a holding temperature of 700°C or more is 1 to 6 hours.

19. The manufacturing method according to any of claims 16 to 18, wherein the holding temperature is 700 to 850°C.

20. The manufacturing method according to any of claims 16 to 19, wherein the activation treatment is performed in a rotary kiln.

21. The manufacturing method according to claim 20, wherein the activation treatment with the rotary kiln is a continuous process.

22. The manufacturing method according to claim 1, wherein the alkali metal in vapor form that is generated during activation treatment is sorbed to the carbon material for sorption by circulating inert gas through the system in at least the activation step and bringing the circulating inert gas into contact for 0.5 seconds or more with the carbon material for sorption that has been heated to a temperature of 300 to 800°C.

23. The manufacturing method according to claim 22, wherein the circulating inert gas has a linear velocity of 1.0 to 10.0 mm/second.

24. The manufacturing method according to claim 1, wherein the granulation step and dehydration step are performed so as to satisfy the following equation (3),

$$[A1/B1] \geqq [A2/B2] \quad (3)$$

where A1 (N) is the crushing strength of the granulation product, B1 (cm) is the diameter of the granulation product obtained in the granulation step, A2 (N) is the crushing strength of the dehydration product, and B2 (cm) is the diameter of the dehydration product obtained in the dehydration step.

25. The manufacturing method according to claim 1, wherein in the mixing step, the carbonaceous material is mixed with the alkali metal hydroxide to which carbonaceous material had been added in an mount of 0.5 to 10 wt% in advance and which had finely been pulverized.

26. The manufacturing method according to claim 25, wherein variation in the composition ratio of the alkali metal hydroxide in relation to carbonaceous material in the granulation and/or dehydration product prepared in the granulating and/or dehydrating steps is held to 5% or less.

27. The manufacturing method according to claim 26, wherein variation in the composition ratio of the alkali metal hydroxide in relation to carbonaceous material is 2% or less.

28. A dehydration product for an activated carbon obtained by mixing a carbonaceous material and an alkali metal hydroxide while maintaining a solid state, granulating the mixture obtained while maintaining its solid state, and dehydrating the granulated substance obtained while maintaining its solid state; wherein this dehydration product for an activated carbon satisfies the following equation (1),

$$[M1/C1]/[M2/C2] \leqq 2.4 \qquad (1)$$

where [M1/C1] is the alkali metal/carbon ratio in the surface layer region thereof, and [M2/C2] is the alkali metal/carbon ratio in the center portion thereof.

29. The activated carbon obtained according to the manufacturing method in any of claims 1 to 27.

30. An activated carbon obtained by activating carbonaceous material with an alkali metal hydroxide, wherein the standard deviations of the relative peak strengths of the graphite D band, the amorphous G band, and the graphite G band in relation to the peak strength of the amorphous D band are 0.05 or less, assuming that the peak strength of the amorphous D band in the Raman spectrum is set to 1 when 20 observation points or more are measured.

31. A polarizable electrode, wherein the activated carbon according to claim 29 or 30, and at least a binder and a conductive filler are mixed and molded.

32. The polarizable electrode according to claim 31, wherein the metal content is 300 ppm or less.

33. The polarizable electrode according to claim 31 or 32, wherein the iron, copper, and nickel contents are each 20 ppm or less.

34. The polarizable electrode according to any of claims 31 to 33, wherein the electrode density of the polarizable electrode is 0.80 g/cc or more.

35. An electric double-layer capacitor having the polarizable electrode according to any of claims 31 to 34.

36. The electric double-layer capacitor according to claim 33, wherein the electrostatic capacity is 30 F/cc or more.

37. The electric double-layer capacitor according to any of claims 33 to 34, wherein the retention rate of the electrostatic capacity is maintained at 90% or more after repeating charging and discharging 500 times, the charging

and discharging consisting of charging with a constant current and discharging with a constant current.

38. A method for manufacturing activated carbon by subjecting a carbonaceous material to an activating treatment with the aid of an alkali metal-containing activator, wherein said method comprises a step for preparing a mixture of a carbonaceous material and an alkali metal-containing activator, a step for heat treating the mixture, a step for using the mixture to obtain a molded product by pressure molding, and a step for using the molded product to perform the heating process of the activation treatment.

39. A method for manufacturing activated carbon by subjecting a carbonaceous material to an activating treatment with the aid of an alkali metal-containing activator, wherein said method comprises a step for preparing a mixture of a carbonaceous material and an alkali metal-containing activator, a step for using the mixture to obtain a molded product by hot pressing at 2 MPa or more and less than 40 MPa, and a step for using the molded product to perform the heating process of the activation treatment.

40. The method of manufacturing activated carbon according to claim 38 or 39, wherein the weight ratio [W_2/W_1] is set to 2.5 or less, where the weight of the carbonaceous material is W_1, and the weight of the alkali metal activator is W_2.

41. The method of manufacturing activated carbon according to any of claims 38 to 40, wherein the alkali metal-containing activator is an alkali metal hydroxide.

42. The method of manufacturing activated carbon according to any of claims 38 to 41, wherein the alkali metal hydroxide is potassium hydroxide.

43. The method of manufacturing activated carbon according to claim 39, wherein the heating temperature of the mixture in the heating treatment and the hot press treatment is set to 300°C or less.

44. The method of manufacturing activated carbon according to claim 38, wherein the pressure applied to the mixture in the molding process of the molded product is 5 MPa or more.

45. The method of manufacturing activated carbon according to claim 39, wherein the pressure applied in the hot press treatment is 2 MPa or more.

46. The method of manufacturing activated carbon according to any of claims 38 to 45, wherein the specific surface area of the activated carbon is 1,000 m^2/g or less.

47. The method of manufacturing activated carbon according to any of claims 38 to 46, wherein the nickel content in the activated carbon is 20 ppm or less.